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CORROSION ZONES IN CARBONATE ROCKS

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Corroded surfaces apparently of a diastemic nature have long been known from Middle Ordovician rocks in the upper Mississippi Valley. Their appearance in the field has not been described adequately, and no illustrations have been published. Because the writer believes that corrosion zones are present in rocks of similar age in other parts of the country, he hopes that this discussion will encourage search for them.

Corrosion zones probably were recognized first by T. C. Chamberlin in the Platteville formation of Wisconsin (Sardeson, 1898, p. 322). Sardeson (1898, 1914, 1926, 1937) discussed occurrences in the upper Mississippi Valley, but devoted most of his attention to corrosion conglomerates. Agnew (1948) referred to a "pitted erosional surface of disconformity" with associated phosphates at the top of the Platteville formation where the overlying Spechts Ferry member is absent (this may correspond to the phosphatic pebbles described by Bain, 1906). Templeton and Willman (1952) mention a corrosion zone near the top of the Pecatonica member of the Platteville formation in northern Illinois. The petrography and petrology of corrosion zones and the associated phosphates was rather fully treated by Pettijohn (1926).

Corrosion zones have been identified at several horizons in the Ordovician rocks of southeastern Minnesota (Weiss, 1953). The top of the Pecatonica member of the Platteville formation is marked by a group of three corrosion zones. Where the member approaches a feather edge toward the northwest only two can be identified with certainty, and it is not known what becomes of them beyond the limit of the member. Toward the southeast, where the member is several feet thick, there are two more corrosion zones near the middle and base of the member. Near the base of the McGregor member of the Platteville there is another corrosion zone. Where this member is underlain by the Pecatonica this corrosion zone maintains a constant interval of four feet above the top of the Pecatonica. A pair of closely-spaced corrosion zones was found in the lower part of the Galena formation at one outcrop. The uppermost part of the Prosser member of the Galena contains as many as six corrosion zones at one locality. Elsewhere there are fewer and these are grouped closely together. In each case the uppermost corrosion zone closely approximates the change from limestone to dolomitic limestone that characterizes the Prosser-Stewartville contact.

Corrosion zones appear in the field as smooth, irregular, or dove-tailed blackened intervals of wide lateral extent. Where fully developed (fig. 1, 2) they display a relationship that cannot possibly have originated other than by partial solution of the lower bed and subsequent deposition of the upper bed without destruction of the pitted surface. Such dove-tailed contacts may, however, grade

laterally into rather smooth blackened contacts for part of their extent along the outcrop. The character of these surfaces on planes parallel to their bedding is well shown in fig. 4. The black stain associated with corrosion zones results largely from finely divided pyrite, but partly also from small amounts of manganese oxide (Stauffer, 1925).

In addition to the color and irregularity of the surface, corrosion zones may show one or more of the following features; 1) a change of rock from below to above, 2) an increase of detrital material from below to above, sometimes with an influx of sand, 3) the presence of abundant collophane above the corrosion surface, in the form of tiny castings (?), organic fragments, small flakes, and rounded or irregular polished granules and pebbles, and 4) corroded pebbles of the subjacent rock apparently suspended in the superjacent matrix (fig. 5). The lowest of the three corrosion zones at the top of the Pecatonica member (fig. 1, 2, 3) is overlain by abundant collophane and quartz sand, whereas the rock immediately under it is nearly free of both. The uppermost of the same group of three corrosion zones (fig. 2, 3) is coated with unusually large amounts of pyrite, the blackened crust containing up to 40 percent of that mineral.

Corrosion zones weather readily to a shaly, rust-colored slot in the outcrop (fig. 2), and are therefore difficult to identify in old exposures.

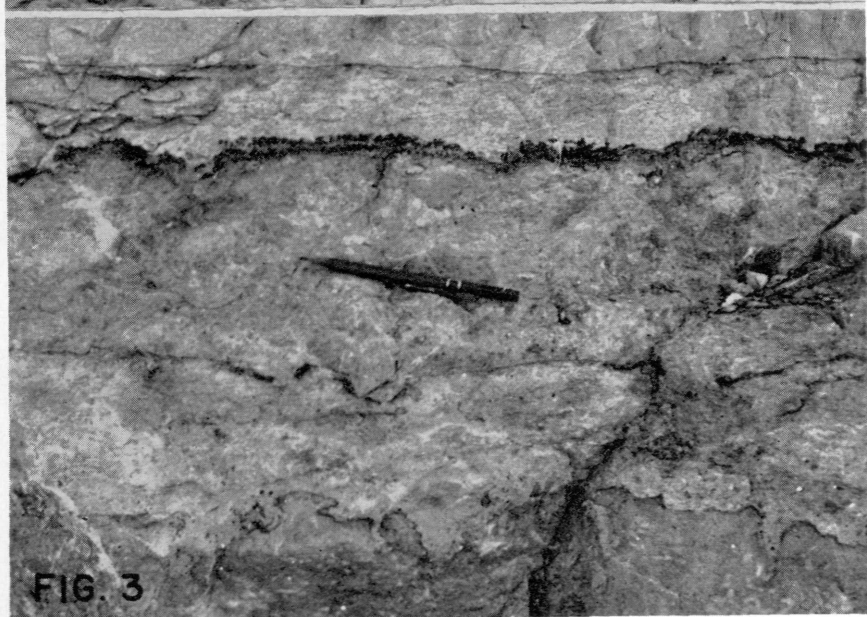
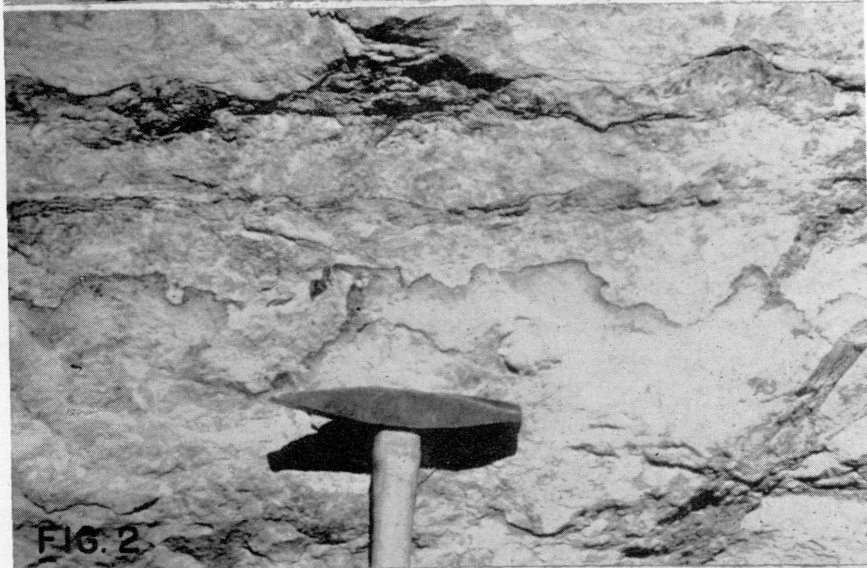
Hudson (1910) illustrated a surface much like that of figure 4 apparently in the process of formation today. He ascribed its formation in the Ordovician limestones of Valcour Island to gentle selective erosion of the shelving bedrock beach. He believed that the ridges of siliceous limestone that are the harder parts of the rock were formed by "vibration" waves on the Ordovician sea bottom. No such anisotropism of hardness and composition appears to be present in the limestone beds underlying the corrosion zones studied in Minnesota. Other etched surfaces figured by Hudson (1909) are pitted by cupholes, and do not resemble corrosion surfaces so closely.

If the Valcour Island occurrence is really a corrosion zone in the process of formation it is doubly remarkable, inasmuch as such features could readily be produced during diagenesis in sediments just stiff enough to hold their shape during deposition of the overlying material. In the Minnesota occurrences no evidence was seen of distortion of the irregular surface by the later sediments. Retardation or lack of deposition, coupled with solution, is the only means by which these surfaces could be produced. They are therefore diastems, but the hiatuses must be very small because of the close similarity of the faunas above and below each corrosion zone. Pettijohn's statement (1926, p. 363) regarding the coincidence of corrosion zones with faunal zone boundaries is not true of the corrosion zones here considered.

The literature of corrosion zones is diffuse, and there is good reason to suspect that they have not always been recognized for what they are. It seems likely that

EXPLANATION OF FIGURES

- FIGURE 1. Ideal specimens of the lowest corrosion zone of a group of three at the top of the Pecatonica member of the Platteville formation; quarry near Mabel, Minnesota (SE cor. Sec. 15, T. 101 N., R. 8 W.). The specimen at the left is five inches tall.
- FIGURE 2. View of the three closely-spaced corrosion zones at the top of the Pecatonica member of the Platteville formation in the wall of the quarry at Mabel, Minnesota (SE Cor. Sec. 15, T. 101 N., R. 8 W.). The middle and upper zones are obscured by weathering.
- FIGURE 3. Group of three closely-spaced corrosion zones at the top of the Pecatonica member of the Platteville formation exposed in the quarry at the RR overpass west of Spring Grove, Minnesota (SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 17, T. 101 N., R. 7 W.). The pencil lies between the middle and upper zones, the latter of which is heavily charged with pyrite or marcasite.



these features are more widespread than has been realized heretofore. The peculiar contact between the Lebanon and Carters limestones in central Tennessee, illustrated by Bassler (1932), has the appearance of a typical corrosion zone. The feature is not described in the text, except for a reference to the color difference in the measured section on page 29. If corrosion zones are really present in Tennessee they may be found in other eastern states in rocks of similar age.

Corrosion zones can be useful stratigraphic tools in the study of Middle Ordovician rocks, at least within regions like the upper Mississippi Valley. Even within these limits their potential value justifies much closer study of these features than they have received in the past. But the possibility that corrosion zones occur widely in Ordovician rocks and also in rocks of other ages should encourage widespread search for them. For these reasons the writer has attempted to direct attention again to these features of carbonate rocks.

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EXPLANATION OF FIGURES

- FIGURE 4.** Block showing the underside of a surface intersecting the lowest of a group of three corrosion zones at the top of the Pecatonica member of the Platteville formation; quarry at the RR overpass west of Spring Grove, Minnesota (SE $\frac{1}{4}$ SE $\frac{1}{4}$ Sec. 17, T. 101 N., R. 7 W.). The dark rock is below the corrosion zone and the light rock is above.
- FIGURE 5.** Group of three closely-spaced corrosion zones at the top of the Prosser member of the Galena formation seen in a loose block on the floor of the Masonic Park quarry near Spring Valley, Minnesota (SE $\frac{1}{4}$ Sec. 11, T. 103 N., R. 13 W.). The knife lies between the middle and upper zones. The weathered slot between the two lower zones is apparently not a corrosion zone. The lower zone shows some corrosion conglomerate.

